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ABSTRACT

The purpose of this research study was to explore the effects of children's trade books on the development of science concepts. The two objectives of this exploratory study were to determine whether children's ideas about specific science concepts change when trade books containing information about those concepts are read to them, and characterize any such changes toward the development of more scientifically valid concepts as positive. The questions which guide the study pertain to prior knowledge, the role of trade books in concept formation, and the nature of the changes in students ideas. The instructional topic of whales is represented in five trade books that are used in the study. For each book, a set of true-false questions is read aloud to students with students recording responses on a prepared answer sheet. The results of the study indicate that the use of trade books may facilitate or interfere with learning and that teacher knowledge and understanding are required for effective use of these books in science instruction. Contains 30 references. (DDR)

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Children's Trade Books: Do They Affect the Development of Science Concepts?

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Background

Reading research since the 1960's has been strongly influenced by Louise Rosenblatt's transactional view of reading (Cooper, 1993; Cox and Zarillo, 1993). According to this model, the reader through prior experience interacts with the print resulting in a unique construction of meaning which varies from reader to reader. Such an interactive-constructivist model is consistent with the constructivist model of learning science (Shymansky, Yore, and Good, 1991).

To date, a significant amount of research in science education has examined reading in science. This research, though addressing a wide range of issues, has focused in one way or another primarily on science textbooks, as seen in a small sampling of such studies appearing in JARST over the last five years (see Alexander and Kulikowich, 1994; Jeffery and Roach, 1994; Koch and Eckstein, 1995; Potter and Rosser, 1992; Shymansky, Yore and Good, 1991; Staver and Lumpe, 1993).

In recent years, one of the methods used in teaching science which has been receiving increased attention, particularly at the elementary level, is the use of children's trade books. Trade books include a variety of types of literature including fiction, nonfiction, biographies, autobiographies, diaries, reports of discoveries, poetry, and science fiction (Daisey, 1994). Though perhaps first recommended by reading educators, the use of trade books in science seems to be gaining attention among science teachers and science educators. In fact one new elementary science methods text includes at least one recommended trade book for each science activity included in the text, a total of almost 150 selections (Martin, 1997).

Proponents of their use, both reading and science educators, have suggested a number of justifications for this growing trend. Some of the many arguments in support of using trade books in teaching science are that they are more relevant and interesting (Casteel and Isom, 1994; Crook and Lehman, 1990; Hammond, 1992; Stiffler, 1992); that they complement weak textbooks (Crook and Lehman, 1990; Stiffler, 1992); that they are less intimidating (Carlile, 1992; Casteel and Isom, 1994; Crook and Lehman, 1990; Stiffler, 1992); and that they "view and celebrate diversity of achievement" (Daisy, p. 133) in contrast to the "poor representation females and minorities in textbooks" (Sleeter and Grant in Daisey, p.

133).

Most of the research focusing on the use of trade books in science, as well as other content areas, has appeared in the reading literature. Research in science education examining the effects of using trade books in teaching science, even cursorily, has been scant (see for example, Lamartino, 1995; Maria and Junge, 1993; Norris and Phillips, 1994; Romance and Vitale, 1992). That children's literature has virtually escaped the notice of science educators is surprising, given the vast literature on constructivist teaching and learning in science. After all, trade books, whether used in science classes or not, are such an obvious source of children's ideas.

From anecdotal information provided by our faculty who work with elementary teachers and teach courses in the elementary graduate degree program, it is apparent that there is a great deal of interest in using trade books in science, as well as in other subjects such as social studies. In addition, more articles addressing this topic are appearing in the practitioner-oriented science education literature such as Science and Children . In light of this trend and given our prior research which identified 38 items of misinformation in six trade books about the moon (Rice and Rainsford, 1996), it would seem imperative that research examining how the construction of children's ideas in science are influenced by trade books be undertaken.

Purpose

The purpose of the research described in this paper was to explore the effects of children's trade books on the development of science concepts. The two objectives of this exploratory study were to 1) determine whether children's ideas about specific science concepts change when trade books containing information about those concepts are read to them; and, 2) to characterize any such changes as, "positive," toward development of more scientifically valid concepts, or "negative," toward the development of less valid or incorrect concepts. Three general questions guided the research:

What prior knowledge do students have about a selected concept?

Will exposure to trade books alter students' existing knowledge about the concept?

Will possible changes in students' ideas be scientifically valid or invalid, inaccurate?

Methods

To answer these questions, the researchers identified 15 children's trade books appropriate for elementary grades on the subject of "whales," eleven fiction and four non-fiction books. Two of the reasons for the selection of this concept were its great appeal to children in this age group and the relatively high availability of children's books about whales. After more critical examination, five of the books, three fantasy and two realistic fiction, were chosen for use in this study. These final selections were made based upon a number of considerations including clarity of text; the relative number of "facts" about whales in the books, particularly those which might be "new" to students; the classroom teachers' assessments of the level of interest in these books demonstrated by students in previous years; an attempt to have a variety of books; and recommendations from a reading educator colleague about which titles are currently among the "hottest" in reading circles.

For each of the five books selected, a set of five to six true-false type questions about the topic, "whales," was developed. The questions were read aloud to the students, and a simple written answer sheet requiring students to circle "yes" or "no" was used to accommodate differing reading levels in the classes.

In developing the questions, the text of each book was first examined to identify facts about whales, both correct and incorrect, communicated in the book. Generally, the ideas were explicitly communicated, though a few were more implicit, for example through the artwork. When necessary, the accuracy of information was verified using various reference sources. The questions were designed to obtain three categories of information: the children's prior knowledge about whales (all questions fit this category); the effects of misleading information presented in the books; and the effects of correct information on the children's ideas.

Two classes of second graders and one of fourth graders at an elementary (K-5) school participated in the study. The classes were a convenience sample selected because the undergraduate student who implemented the study was assigned to the second grade classes for a reading practicum and their teachers

were interested in the topic of the study. Subsequently, the teacher of a fourth grade class became interested in the study and volunteered her class for the project. In one of the second grade classes, "Class A," there were 11 girls and 12 boys; in the other, "Class B," there were 21 students, 11 girls and 10 boys. There were 28 students in the fourth grade class, 13 females and 15 males. Approximately twenty percent of the students in each of the classes were African-American, a number closely reflecting the racial make-up of the school. No other minority groups were represented.

Data were collected in the second grade classes over a five week period; in the fourth grade class over a period of two weeks. Before hearing a book, students completed a "pretest" form of the set of questions related to that book. After the book was read and prior to any discussion of the subject matter, an identical post-test was administered to the class. Subsequently, the researcher led the class in a discussion to explore students' ideas about whales and to identify and address any invalid ideas the children retained, whether they were an apparent result of the reading or not.

Three books were read to "Class A," two to "Class B," and three to the fourth grade class. Questions related to each of the books and the identity of the classes to which each was read follow.

The Whales, by Cynthia Rylant (1996) read to Class "A" and the fourth grade class:

1. Do whales dream?
2. Can whales make a wish?
3. Do whales have a sense of smell?
4. Do baby whales drink their mother's milk?
5. Do whales breathe air like people?

I Wonder If I'll See a Whale, by Frances Ward Weller (1991) which was read to Class "B":

1. Can whales talk to people?
2. Are whales fish?
3. Do baby whales drink their mother's milk?
4. Do whales live in the ocean?
5. Do whales jump?

Dear Mr. Blueberry by Simon James (1991), read to Class "B," and the fourth grade class:

1. Do whales eat people food?
2. Can you pet a whale at the beach?

3. Can whales live in a pond?
4. Do whales travel great distances every day?
5. Can whales live in an ocean?
6. Do whales jump?

The story, "The Three Gray Whales," in Animals Who Have Won Our Hearts, by Jean Craigehead George (1994) read to "Class A":

1. Can whales drown?
2. Do whales breathe air like people?
3. Do whales eat during the winter?
4. Can whales talk to people?
5. Can whales sing a song?

Whale Song, by Tony Johnston (1987), read to Class "A" and the fourth grade class:

1. Can whales sing a song?
2. Do whales eat at the bottom of the sea?
3. Can whales hear?
4. Do whales travel in groups?
5. Do whales count?
6. Do whale babies (calves) sleep?

Results

Tables 1 and 2 included at the end of this paper present data concerning the numbers of pre-post answer changes for each book. The "+" indicates a change from an incorrect to a correct answer; "nc" indicates no change in answers; "-" refers to a change from a correct to an incorrect answer. In addition, each question is labeled with either "corr" or "inc," indicating whether the information relative to that particular question presented in the book was correct or incorrect.

For the first book to be considered, Whale Song, on three questions (2-4), there were relatively few changes in the second grade students' answers pre- to post-test. On one question, "Can whales sing a song?", 14 students changed their answers to the correct answer, "yes," after having heard the book. This shift apparently resulted from the clear statement in the book that whales sing songs.

For two of the questions based upon Whale Song there were definite shifts in the second graders' responses from correct to incorrect answers. To the question, "Do whales count?, students were

unanimous in answering "no" on the pretest; however, 14 changed their answers to "yes" (an incorrect answer) on the post-test, perhaps not surprising since this book is a "counting book". The other statement which apparently had a negative influence on responses to the second question appears near the end of the book, "Softly she sings, six, six, six. But does her calf sleep? No! He just laughs and sings seven!" When asked, "Do whale babies (calves) sleep?", 11 students changed their answers to an incorrect, "no" while only one student changed to the correct answer, "yes."

In examining fourth graders' responses to Whale Song, it appears that the book negatively affected children's ideas in much the same way that it did with the second graders. To the question, "Do whales count?, 18 children changed their answers to the incorrect, "yes," In response to "Do whale babies (calves) sleep, 13 of 25 children responding changed their answers to "no" after having listened to the book. Overall, of the 55 answer changes made by the fourth graders in response to Whale Song, 50 of these changes were to the "wrong" answer.

Unlike the case of Whale Song, where second graders made 45 total pre- to post answer changes, "The Three Gray Whales" by Jean C. George had little effect upon students' ideas about whales. When comparing pre- and post- responses, it was noted that there were a total of 21 instances in which answers changed after the reading of the story. These changes were pretty evenly split between changes to correct and incorrect answers. As examples, two of the questions asked were "Can whales drown?" and "Do whales breathe air like people?"

One book which is currently very popular among elementary teachers is The Whales by well-known children's author, Cynthia Rylant. An examination of second graders' responses to the reading of this book show pre- to post changes in 50 instances. Of these, changes to the incorrect answer were almost twice as common as changes to the correct answer.

Fourth graders also seem to have been highly influenced by information presented in Rylant's book, with 39 pre- to post answer changes. Unlike second the second graders, however, the fourth graders tended to change to correct or incorrect answers in about even numbers. Large numbers of changes from

correct to incorrect answers to questions 1 and 2 were noted for both second and fourth graders.

In two instances, a question was repeated on a subsequent set of questions asked in "Class A." Examination of answers to these questions indicate that students were retaining "correct" information over at period of at least two to three weeks . In one case, the post-test after the reading of "Three Gray Whales" indicated that the majority of the class had the erroneous idea that whales do not breathe like people (only 7 of 21 present that day said "yes" on the post-test). However, it appears that the discussion after the post-test, held in order to correct any "misconceptions" the children maintained, had its intended effect. On the pretest before the subsequent reading of The Whales, 15 students answered "yes" to the same question.

In the second instance, hearing the book resulted in an overwhelming change in answers to the question, "Can whales sing a song?" When Whale Song was read, on the pretest only 5 said, "yes," whereas on the post-test, 19 indicated that whales can sing. This change in ideas persisted as indicated by the pretest given before reading "The Three Gray Whales" a week later. At that time, 16 of the students in the class still maintained that whales can sing.

Discussion

With regard to the first question addressed in the study, results indicate that the second and fourth graders participants were reasonably knowledgeable about whales. An examination of the pretests for second graders shows, for example, that approximately 58% of the total of 569 answers given on the pretests were correct. The number of students in the fourth grade class was larger (28) than either of the second grade classes and a slightly larger number of students in the fourth grade class were present on days when books were read (24 or 25). However, since only three books were read to the fourth grade class, the total number of pre-test answers was less, only 420. Of these, the fourth graders answered approximately 76% correctly.

In two instances, both of the second grade classes were asked the same question. To one of these questions, "Can whales talk to people?", on the pretest, 36 of 42 children in the two classes (86%)

answered correctly, "no". In the second instance, 26 of 44 (59%) children present answered correctly in response to the pretest question, "Do baby whales drink their mother's milk?"

On other questions answered by only one of the second grade classes, the children also demonstrated that they were knowledgeable about other characteristics of whales. For example, 18 of 21 students knew that whales can hear; 17 of 18 responded that whales live in the ocean; 16 of 18 knew that whales don't eat "people food." When asked these same three questions, the number of correct responses from the fourth graders to the question about whales' ability to hear was 22 of 25; to the question about whales living in the ocean, all 25 responded correctly. Surprisingly, to the third question about "people food," only 12 of the 24 fourth grade responding gave the correct answer on the pretest.

It is important to note that information in the book relative to this question about whales eating "people food" was incorrect, and this question is one of the instances in which students' ideas were "negatively" affected by listening to the book. In contrast to the pretest answers described in the previous paragraph, an examination of post-test answers to this question showed that only 12 of 18 second graders answered, "no," and of the 24 fourth graders, only 6 responded correctly on the post-test!

Some students knew (or guessed) facts about whales which are less commonly known. For example four second grade and seven fourth grade students responded correctly that whales do not have a sense of smell. In this case, hearing the story had a positive effect as 19 second graders and 18 fourth graders answered correctly, "no" to the question on the post-test.

As to the issue of whether exposure to trade books changed the children's ideas about whales, the answer is a resounding, "yes"! An examination of individual children's pre- and post-tests revealed that there were no changes in answers pre to post on just three of the 27 questions answered by second graders and two of the 17 questions answered by fourth grader. Actually, only two questions put to the second graders demonstrated no change as one question was repeated. Interestingly, the two questions were the same for the second and fourth graders: "Can whales jump?" and "Can whales live in an ocean?"

Of course, the key question is whether students' ideas about whales were becoming more accurate,

more valid, or not. An examination of the data indicates that the answer is, "both." The two examples already described clearly demonstrate this. In the case of the "people food" question, a negative effect was noted, and in the instance of the question about whales' sense of smell, a positive effect resulted.

Overall, of the total number of changes from pre- to post-test observed in the study, 60% of the changes in answers made by second graders were from correct to incorrect, and obviously 40% were from incorrect to correct. The corresponding percentages for fourth graders were 75% and 25%. (In terms of "per child" number of changes, there was no difference between second and fourth graders.) What this means of course is that the students were "picking up" a great deal of misinformation as well as correct information from the children's trade books read to them in class.

The magnitude of the "misinformation" problem is amazingly clear if one compares the quality of the information presented in the books with the nature of the pre to post changes in answers related to the corresponding books. In the case of 12 of the questions asked in the study, incorrect information was presented in the books read to the children. For nine of those questions, there were very large pre-post shifts to the incorrect answer. In fact, only two other questions demonstrated comparable negative shifts--both of these related to the reading of Mr. Blueberry.

Further examination of the Mr. Blueberry question sets demonstrates in a slightly different way how information presented in the books influenced the children's ideas. In the four books other than Mr. Blueberry, the information presented relative to a given question was either correct or incorrect. In Dear Mr. Blueberry, "both sides of the coin" were presented. That is, the character Mr. Blueberry responds in the book to a little girl's incorrect ideas about whales by giving the correct information.

Tables 1 and 2 indicate that for the set of questions based upon Mr. Blueberry there were 28 pre-post answer changes in answers for the fourth graders and 13 for the second graders. In contrast, as many as 55 changes were made in the case of Whale Song when it was read to the fourth graders and 50 when The Whales was read to the second graders. Considering the differences between the number of answer changes after the reading of Mr. Blueberry and after reading the other two books, it appears that the

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children in the study tended to accept the information in books as "fact," whether correct or incorrect. That is, the inclusion of both correct and incorrect information seems to have provided support for the children's prior knowledge, whether correct or incorrect, and they apparently saw no reason to change their answers.

In the case of only one other book were there fewer changes than the number observed in the reading of Mr. Blueberry --that was in the reading to one of the second grade classes of I Wonder If I'll See a Whale by Frances Welier. In that instance, there were only eight answer changes to the five questions. Interestingly, correct information was given in this book relative to four of the five questions.

Conclusions

"Advocates of using children's fiction in teaching science contend such books facilitate learning, however this point of view has its opponents who insist that this form of literature interferes with science learning" (Rice and Rainsford, 1996, p. 2). The results of this study indicate that the use of trade books may facilitate or interfere with students' learning, that is, children learn both correct and incorrect information from this form of literature.

Given the increased use of trade books in teaching science, our findings suggest that teachers should exercise care in the selection and use of trade books in the science classroom. Teachers should be very critical and choose books which present the most accurate information in terms of the science concepts presented. Elementary teachers must keep in mind that children, particularly young children, are not always able to separate fact from fiction. Further, teachers themselves must be sure that they understand the science concepts, and that in selecting trade books for use in science classes, they are able to identify misinformation and errors which may be found in such books. With the increasing use of trade books across the curriculum, guidelines to help teachers choose the most appropriate books for teaching science are becoming more readily available and should be utilized (Mayer, 1995; Sudol and King, 1996).

This exploratory study considered just two types of trade books, fantasy and realistic fiction. There are a number of other types of trade books including non-fiction informational books which warrant examination and, before trade books of any genre become an accepted, integral part of the science

curriculum, a number of issues should be considered. Some of the more pragmatic directions which such research might take include the comparative analysis of the quality of the science presented in various types of trade books and other non-text written resources; an examination of how trade books are best utilized in the science classroom; in-depth studies of the relative effects of trade books on science achievement, attitude, and other outcome variables; comparative studies of possible differential effects for different student populations; and a determination of long-term retention effects. With over 50,000 children's trade books in print and 4,000 new ones being published each year (Lynch-Brown and Tomlinson, 1993), the results of this study indicate that further research examining the use of children's trade books in teaching science is essential.

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Table 1: Number Pre to Post Answer Changes for Second Grade

Whale Song	+	n c	-	
1. Can whales sing a song?	14	7	0	corr
2. Do whales eat at the bottom of the sea?	1	20	0	inc
3. Can whales hear?	2	18	1	corr
4. Do whales travel in groups?	1	20	0	corr
5. Do whales count?	0	7	14	inc
6. Do whale babies (calves) sleep?	1	9	11	inc

"The Three Gray Whales" in Animals Who Have Won Our Hearts	+	n c	-	
1. Can whales drown?	4	16	1	incon*
2. Do whales breathe air like people?	1	19	1	corr
3. Do whales eat during the winter?	3	15	3	corr
4. Can whales talk to people?	2	14	5	inc
5. Can whales sing a song?	0	20	1	repeat

The Whales	+	nc	-	
1. Do whales dream?	3	11	9	inc
2. Can whales make a wish?	0	8	15	inc
3. Do whales have a sense of smell?	6	6	1	corr
4. Do baby whales drink their mother's milk?	9	13	1	corr
5. Do whales breathe air like people?	1	17	5	corr

Dear Mr. Blueberry	+	nc	-	
1. Do whales eat people food?	1	12	5	both
2. Can you pet a whale at the beach?	0	15	3	corr
3. Can whales live in a pond?	1	15	2	both
4. Do whales travel great distances every day?	0	18	0	corr
5. Can whales live in an ocean?	1	17	0	both
6. Do whales jump?	0	18	0	corr

Wonder If I'll See a Whale	+	nc	-	
1. Can whales talk to people?	0	20	1	corr
2. Are whales fish?	0	20	1	corr
3. Do baby whales drink their mother's milk?	4	15	2	corr
4. Do whales live in the ocean?	0	21	0	corr
5. Do whales jump?	0	21	0	corr

*incon=inconclusive

Table 2: Number Pre to Post Answer Changes for Fourth Grade

Whale Song	+	nc	-	
1. Can whales sing a song?	2	23	0	corr
2. Do whales eat at the bottom of the sea?	0	8	17	inc
3. Can whales hear?	1	24	0	corr
4. Do whales travel in groups?	2	21	2	corr
5. Do whales count?	0	7	18	inc
6. Do whale babies (calves) sleep?	0	12	13	inc

Dear Mr. Blueberry	+	nc	-	
1. Do whales eat people food?	2	16	7	both
2. Can you pet a whale at the beach?	0	14	11	corr
3. Can whales live in a pond?	1	21	3	both
4. Do whales travel great distances every day?	3	20	1	corr
5. Can whales live in an ocean?	0	25	0	both
6. Do whales jump?	0	25	0	corr

The Whales	+	nc	-	
1. Do whales dream?	1	15	9	inc
2. Can whales make a wish?	1	14	10	inc
3. Do whales have a sense of smell?	11	13	0	corr
4. Do baby whales drink their mother's milk?	1	23	1	corr
5. Do whales breathe air like people?	5	20	0	corr